SON Number: ERSON-18-C1 **October 27, 2016**

Strategic Environmental Research and Development Program (SERDP)

FY 2018 STATEMENT OF NEED

Environmental Restoration (ER) Program Area

IMPROVED UNDERSTANDING OF PER- AND POLYFLUOROALKYL SUBSTANCE SOURCE ZONES

1. Objective of Proposed Work

The objective of this Statement of Need (SON) is to improve our understanding of per- and polyfluoroalkyl substances (PFASs) in source zones resulting from the use of Aqueous Film Forming Foam (AFFF) formulations by the Department of Defense (DoD). In particular, the goal is to better understand the fate of precursor compounds and the role they play in sustaining perfluoroalkyl acid (PFAA) groundwater plumes, as well as the contribution to groundwater contamination of residual PFAS mass in near surface soils. Ultimately, the ability to better characterize and model the nature of sources (and associated plumes) should lead to more targeted remediation strategies based on prioritizing areas posing the greatest risk.

Specific objectives include:

1. Increase understanding of the key characteristics of AFFF source zone areas (vadose zones and/or saturated zone source areas) that affect the risk that PFASs pose to groundwater quality.
2. Development of tools and methods to better characterize the key source zone properties.
3. Investigate the nature and permanence of PFAS retardation mechanisms, and the potential use of these mechanisms in natural or enhanced attenuation.
4. Fill key data gaps regarding the biotransformation and transport of PFASs in AFFF source zones.
5. Develop analytical or mathematical tools to predict the fate and impacts of PFASs in source zones and the potential for continuing releases to groundwater plumes.

Proposals may address one or more of the objectives listed above; however, all proposals must demonstrate how the proposed research will ultimately be used to improve management of PFAS-contaminated sites. Research and development activities at laboratory-, bench-, and field-scale will be considered. Work does not necessarily have to culminate in a field-scale effort.

2. Expected Benefits of Proposed Work

Research should lead to improved management of PFAS sites, specifically for residual contamination characteristic of aged source zones with particular emphasis on perfluorooctane sulfonate (PFOS)-containing AFFF agents. Products should provide tools and guidance to users (i.e., Remedial Program Managers) on effective management options for such sites. Further, this information will be used to support cost-benefit analyses of treatment methods and management strategies. The resulting tools and understanding should improve the ability to implement effective remedial strategies at DoD sites.

3. Background

AFFF formulations have been used by DoD since the 1970s to suppress fires, and there are hundreds of sites with associated PFAS contamination. DoD used AFFF mixtures containing significant quantities of PFOS and related perfluoroalkyl sulfonates such as perfluorohexane sulfonate (PFHxS) until 2002, when production stopped. However the DoD continued (until only recently) to use PFOS-containing AFFF stocks. Although the DoD's legacy use of AFFF included various fluorotelomer-based formulations, the vast majority of DoD's environmental liability likely results from the use of PFOS-based AFFF. Additional research on PFAS is timely given USEPA's recent drinking water health advisories for two common PFASs, perfluorooctanoic acid (PFOA) and PFOS as well as the numerous states that are beginning to promulgate drinking water standards.

Many of the PFASs found in AFFF formulations are highly soluble and migrate rapidly, while others are far less mobile. The more soluble PFASs are likely to become depleted through flushing from source zones over time. However, other PFAS compounds may be retained in the source zone, with varying degrees of potential for mass transfer into the aqueous phase, infiltration to groundwater (for vadose zone source areas), and/or groundwater migration, particularly after several years in the subsurface. PFOS and PFOA are relatively mobile, though their fates are complicated by the presence of potential precursors for these compounds in complex PFAS mixtures such as AFFF formulations.

The risks posed by PFASs retained in the original source zones are not fully understood, in part because several mechanisms may be involved. PFASs may be sorbed to organic or inorganic solids in the vadose zone or aquifer, and different mechanisms may be involved in such sorption. Soil properties and groundwater geochemistry within source zones will influence the nature of binding mechanisms. Also, the chemical nature of the PFASs that are likely to dominate the original source zones may lead to low risks to groundwater. For example, cationic and zwitterionic PFAS compounds found in AFFF formulations can be very tightly bound to ion exchange sites.

Additionally, precursor compounds may be present and biotransformed to PFAAs. However, the ultimate potential, rate, and pathways of in situ biotransformation remain unclear, particularly for PFOS and related compounds such as PFHxS. Furthermore, regulated PFASs (and their precursors) could be present in lower-conductivity regions, diffusing into the plume over time, or the remaining PFASs may be sequestered in inaccessible forms and pose little or no risk to downgradient groundwater. Finally, other materials often found in AFFF source zones (e.g., NAPLs, petroleum fuels, and chlorinated solvents) may impact the fate of PFASs.

Closing the data gaps on biotransformation and potential transport of PFOS-containing AFFF mixtures is needed to manage these sites cost-effectively. Better characterization of PFAS in source zones can help managers determine how much, if any, active remediation is needed. However, the ability to make such risk-based characterizations is limited by the complexity of PFAS chemistry in general, and our understanding of PFAS interactions within the subsurface environment.

4. Cost and Duration of Proposed Work

The cost and time to meet the requirements of this SON are at the discretion of the proposer. Two options are available:

Standard Proposals: These proposals describe a complete research effort. The proposer should incorporate the appropriate time, schedule, and cost requirements to accomplish the scope of work proposed. SERDP projects normally run from two to five years in length and vary considerably in cost consistent with the scope of the effort. It is expected that most proposals will fall into this category.

Limited Scope Proposals: Proposers with innovative approaches to the SON that entail high technical risk or have minimal supporting data may submit a Limited Scope Proposal for funding up to $200,000 and approximately one year in duration. Such proposals may be eligible for follow-on funding if they result in a successful initial project. The objective of these proposals should be to acquire the data necessary to demonstrate proof-of-concept or reduction of risk that will lead to development of a future Standard Proposal. Proposers should submit Limited Scope Proposals in accordance with the SERDP Core Solicitation instructions and deadlines.

5. Point of Contact

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For Core proposal submission due dates, instructions, and additional solicitation information, visit the SERDP website.